Contents

Abbreviations ..... **Error! Bookmark not defined.**
Executive Summary ..... **Error! Bookmark not defined.**
1.0 Introduction ..... **Error! Bookmark not defined.**
2.0 Background ..... **Error! Bookmark not defined.**
3.0 Remedial Actions ..... **Error! Bookmark not defined.**
3.1 Remedial Action Objectives ..... **Error! Bookmark not defined.**
3.2 Remedy Selection ..... **Error! Bookmark not defined.**
3.3 Remedy Implementation ..... **Error! Bookmark not defined.**
3.3.1 Regulatory Framework ..... **Error! Bookmark not defined.**
3.3.2 Institutional and Physical Controls ..... **Error! Bookmark not defined.**
3.3.3 Other Remedy Components ..... **Error! Bookmark not defined.**
4.0 Progress Since the Last Five-Year Review ..... **Error! Bookmark not defined.**
5.0 Five-Year Review Process ..... **Error! Bookmark not defined.**
5.1 Community Notification and Involvement ..... **Error! Bookmark not defined.**
5.2 Document Review ..... **Error! Bookmark not defined.**
5.3 Data Review ..... **Error! Bookmark not defined.**
5.4 Site Inspection ..... **Error! Bookmark not defined.**
6.0 Technical Assessment ..... **Error! Bookmark not defined.**
6.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents? **Error! Bookmarl**
6.1.1 Institutional and Physical Controls ..... **Error! Bookmark not defined.**
6.1.2 Groundwater Monitoring ..... **Error! Bookmark not defined.**
6.1.3 Surface Water Monitoring ..... **Error! Bookmark not defined.**
6.1.4 Operation and Maintenance of Remedy Components **Error! Bookmark not defined.**
6.1.5 Operations and Maintenance Costs ..... **Error! Bookmark not defined.**
6.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Still Valid? **Error! Bookmark not defined.**
6.2.1 Evaluation of Changes in Standards ..... **Error! Bookmark not defined.**
6.2.2 Evaluation of Changes in Toxicity Data ..... **Error! Bookmark not defined.**
6.2.3 FYR Risk Evaluation Summary ..... **Error! Bookmark not defined.**
6.2.4 RAO Status ..... **Error! Bookmark not defined.**
6.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy? ..... **Error! Bookmark not defined.**
7.0 Issues, Recommendations, and Follow-Up Actions ..... **Error! Bookmark not defined.**
8.0 Protectiveness Statement ..... **Error! Bookmark not defined.**
9.0 Next Review ..... **Error! Bookmark not defined.**
10.0 References ..... **Error! Bookmark not defined.**

Figures

Figure 1. Site Map ..... **Error! Bookmark not defined.**
Figure 2. Central Operable Unit Features ..... **Error! Bookmark not defined.**
Figure 3. TCE Concentrations at AOC Well 10304 (2004–2016). **Error! Bookmark not defined.**
Figure 4. Sentinel Well Locations ..... **Error! Bookmark not defined.**

Figure 5. Uranium Concentrations at WALPOC (2011–2016) .....**Error! Bookmark not defined.**
Figure 6 .....**Error! Bookmark not defined.**

Tables

Table 1. Remedial Action Objectives and Remedy Summary .....**Error! Bookmark not defined.**
Table 2. Institutional Controls .....**Error! Bookmark not defined.**
Table 3. Status of the Third FYR Report Recommendations .....**Error! Bookmark not defined.**
Table 4. Fourth FYR RAO Status..... 9
Table 5 6

Appendices

Appendix A Site Chronology
Appendix B *Rocky Flats Legacy Management Agreement* Attachment 2
Appendix C Risk Assessment Review for COU, POU, and OU3
Appendix D RFLMA Contact Records
Appendix E Surface and Groundwater Monitoring
Appendix F Documents Reviewed
Appendix G Site Inspection Checklist
Appendix H Changes to Applicable, Relevant and Appropriate Requirements
Appendix I Responses to Stakeholder Input on the FYR
Appendix J *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*

6.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Still Valid?

Based on the evaluation presented in this section, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy are still valid and revision of the RAOs is not necessary. There were no changes in exposure pathways or assumptions during this FYR period; land use in the COU remains consistent with the Rocky Flats Wildlife Refuge land use assumption in the CAD/ROD. There were some revisions to surface water quality standards and toxicity data, which are discussed below.

A review of the CAD/ROD ARARs was conducted to determine whether there have been any promulgated changes to statutes or regulations relevant to the chemicals, location, and/or action addressed by the CAD/ROD during this FYR period. Appendix H summarizes the ARAR changes. None of the ARAR revisions effect remedy protectiveness.

6.2.1 Evaluation of Changes in Standards

The remedy performance standards for surface water and groundwater at the Site are the Colorado surface water quality standards identified as ARARs in the CAD/ROD. These standards are directly relevant to groundwater RAOs 1 and 2, surface water RAO 1, and soil RAOs 1 and 2 (

Table *3. Fourth FYR RAO Status*

RAO	Remedy	FYR S
Groundwater		
1. Meet groundwater quality standards, which are the Colorado Water Quality Control Commission surface water standards, at groundwater AOC wells.	• GW monitoring at AOC wells	This RAO was met at all AOC wells c exception. A reportable condition for in 2015 (Section Error! Reference s with the RFLMA parties (CR 2015-10 condition to ensure the remedy rema FYR period, the most recent semiann concentration above the RFLMA star Analytical results from samples colle Woman Creek have not exceeded th during the evaluation period. The rer long-term because: (1) the 2016 data TCE concentration in this well, (2) TC water samples from Woman Creek c and (3) increased concentrations of T Woman Creek under conditions of hi were predicted at Site closure (Kaise
2. Restore contaminated groundwater that discharges directly to surface water as base flow, and that is a significant source of surface water, to its beneficial use of surface water protection wherever practicable in a reasonable timeframe. This is measured at groundwater Sentinel wells. Prevent significant risk of adverse ecological effects.	• GW monitoring at Sentinel wells • Monitoring & maintenance of GW treatment systems • GW treatment prior to reaching SW	This RAO was not met at all Sentinel Sentinel well data exceeded RFLMA and uranium. Optimization and techn the SPPTS, MSPTS, and ETPTS we during this FYR period through the R 2012-02, 2014-01, 2014-04, 2014-08 2016-02). Optimization of the system nitrate and VOC concentrations in GW the Walnut Creek drainage (see Sec found.). Optimization of the GW trea accordance with CRs 2015-08, 2015 remedy remains protective. The ecological risk assessment conc there is no significant risk of adverse evidence of adverse biological condit morbidity) was observed during mon during this FYR period (2012 – 2016
3. Prevent domestic and irrigation use of groundwater contaminated at levels above MCLs.	ICs • Drinking/agricultural SW use prohibited. • GW well drilling prohibited. • Any activities that interfere with remedy actions prohibited except when in accordance w/ RFLMA.	This RAO was met for this FYR perio the environmental covenant have be and irrigation use of groundwater fro routine inspections confirm that no u occurred at the Site during this FYR source not found.).
Surface Water		

RAO	Remedy	FYR S
1. Meet surface water quality standards, which are the Colorado Water Quality Control Commission surface water standards.	• SW monitoring at POCs	This RAO was not met at WALPOC f 12-month rolling average for U excee quality standard for a 4-month period Reference source not found.). Con (CR 2015-01) resulted in a plan to ev remedy remains protective. Evaluatio system suggests that the increase in attributable to heavy precipitation eve U and increase the volume of ground (Wright Water Engineers, 2015). The because (1) no new anthropogenic s varying levels of U may be explained concentrations exiting the COU have drinking water standards. Although th directly applicable to the Site, compa standard offers perspective on the qu site.

RAO	Remedy	FYR S
Soil		
1. Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.	• GW monitoring at Sentinel wells • GW treatment prior to reaching SW	This RAO was not met at all Sentinel Sentinel well data exceeded RFLMA and uranium. Optimization and techn the SPPTS, MSPTS, and ETPTS we during this FYR period through the R 2012-02, 2014-01, 2014-04, 2014-08 2016-02). Optimization of the system nitrate and VOC concentrations in G the Walnut Creek drainage (see Sec GW treatment systems will continue 2015-09, and 2016-02 to ensure the
2. Prevent migration of contaminants that would result in exceedances of surface water RAOs.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR perio to prohibit soil disturbance without ap A reportable condition relating to the was detected in 2013, following a se RFLMA parties consulted on this rep plan to address the condition (CR 20 observations, additional evaluation w 09, 2015-03, 2015-06, 2016-03, and remains protective. Several repairs t system were completed during this F Reference source not found.) and Groundwater and surface water mon FYR period do not suggest the hillsid negatively affected groundwater or s
3. (Part 1) Prevent exposures that result in an unacceptable risk to the WRW. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at the site or multiple pathways of exposure (40 Code of Federal Regulations 300.430[e][2][i][A][2]).	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components ICs: • Perimeter signage • Activity restrictions • GW use restrictions • Digging restrictions • Construction restrictions	This RAO was met for this FYR perio assumptions for a wildlife refuge wor remain valid and human health risk r (Section 6.2.2). Institutional controls unacceptable exposures, including v place and effective, based on RFLM (Section Error! Reference source n A reportable condition relating to the was detected in 2013, following a se RFLMA parties consulted on this rep plan to address the condition (CR 20 observations, additional evaluation w 09, 2015-03, 2015-06, 2016-03, and remains protective. Several repairs t system were completed during this F Reference source not found.) and Groundwater and surface water mon FYR period do not suggest the repor negatively affected groundwater or s
(Part 2) Prevent significant risk of adverse ecological effects.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR perio conclusions remain valid and indicat adverse ecological effects at the Site conditions (e.g., unexpected mortalit during monitoring and maintenance a (2012 – 2016).

). Changes to these standards may impact remedy protectiveness and must be evaluated in the FYR process.

The surface water standards applicable to the COU are based on (1) Colorado WQCC regulation # 31, "Colorado Basic Standards and Methodologies for Surface Waters" (5 CCR 1002-31), which are statewide basic standards, and (2) Colorado WQCC regulation #38, "Classification and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin" (5 CCR 1002-38), which are site-specific standards. The Walnut and Woman Creek portions in the COU are Big Dry Creek segments 4a and 5 of the South Platte River Basin. Because the use classification of groundwater in the COU is surface water protection, the applicable surface water standards also apply to groundwater.

The surface water standards for eight chemical constituents were revised within this FYR period (see CR 2012-03). The standards for five of these constituents (acrylamide, carbon tetrachloride, hexachloroethane, nitrobenzene, and tetrachloroethene) increased and therefore, do not impact remedy protectiveness. The standard for *cis*-1,2-dichloroethene was changed to a range of concentrations (0.014 to 0.070 mg/L). As a result of consultation with the RFLMA parties, the higher number in the range (0.070 mg/L) was retained as the RFLMA surface water standard. The higher standard was the same as the previous RFLMA standard for *cis*-1,2-dichloroethene, therefore, remedy protectiveness was not impacted. The standards for two constituents (1,4-dioxane and pentachlorophenol) decreased from the previous standards. Neither of these two constituents were identified as analytes of interest in any media at the site in the RI/FS report (add reference). A review of groundwater and surface water monitoring data from this FYR period (2012–2016) indicate that neither of these two constituents was detected at concentrations above the revised RFLMA standards.

6.2.2 Evaluation of Changes in Toxicity Data

The remedy performance standards for soil in the COU are site-specific, risk-based values calculated using the exposure assumptions for a wildlife refuge worker (WRW). These standards, referred to as preliminary remediation goals (PRGs), were used to identify COCs at the site and are directly relevant to the evaluation of soil RAO 3 (

Table *3. Fourth FYR RAO Status*

RAO	Remedy	FYR S
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4. Meet groundwater quality standards, which are the Colorado Water Quality Control Commission surface water standards, at groundwater AOC wells.	• GW monitoring at AOC wells	This RAO was met at all AOC wells c exception. A reportable condition for in 2015 (Section Error! Reference s with the RFLMA parties (CR 2015-10 condition to ensure the remedy rema FYR period, the most recent semiann concentration above the RFLMA star Analytical results from samples colle Woman Creek have not exceeded th during the evaluation period. The rer long-term because: (1) the 2016 data TCE concentration in this well, (2) TC water samples from Woman Creek c and (3) increased concentrations of T Woman Creek under conditions of hi were predicted at Site closure (Kaise
5. Restore contaminated groundwater that discharges directly to surface water as base flow, and that is a significant source of surface water, to its beneficial use of surface water protection wherever practicable in a reasonable timeframe. This is measured at groundwater Sentinel wells. Prevent significant risk of adverse ecological effects.	• GW monitoring at Sentinel wells • Monitoring & maintenance of GW treatment systems • GW treatment prior to reaching SW	This RAO was not met at all Sentinel Sentinel well data exceeded RFLMA and uranium. Optimization and techn the SPPTS, MSPTS, and ETPTS we during this FYR period through the R 2012-02, 2014-01, 2014-04, 2014-08 2016-02). Optimization of the system nitrate and VOC concentrations in GW the Walnut Creek drainage (see Sec found.). Optimization of the GW trea accordance with CRs 2015-08, 2015 remedy remains protective. The ecological risk assessment conc there is no significant risk of adverse evidence of adverse biological condit morbidity) was observed during mon during this FYR period (2012 – 2016
6. Prevent domestic and irrigation use of groundwater contaminated at levels above MCLs.	ICs • Drinking/agricultural SW use prohibited. • GW well drilling prohibited. • Any activities that interfere with remedy actions prohibited except when in accordance w/ RFLMA.	This RAO was met for this FYR perio the environmental covenant have be and irrigation use of groundwater fro routine inspections confirm that no u occurred at the Site during this FYR source not found.).
Surface Water		

RAO	Remedy	FYR S
2. Meet surface water quality standards, which are the Colorado Water Quality Control Commission surface water standards.	• SW monitoring at POCs	This RAO was not met at WALPOC f 12-month rolling average for U excee quality standard for a 4-month period Reference source not found.). Con (CR 2015-01) resulted in a plan to ev remedy remains protective. Evaluatio system suggests that the increase in attributable to heavy precipitation eve U and increase the volume of ground (Wright Water Engineers, 2015). The because (1) no new anthropogenic s varying levels of U may be explained concentrations exiting the COU have drinking water standards. Although th directly applicable to the Site, compa standard offers perspective on the qu site.

RAO	Remedy	FYR S
Soil		
4. Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.	• GW monitoring at Sentinel wells • GW treatment prior to reaching SW	This RAO was not met at all Sentinel Sentinel well data exceeded RFLMA and uranium. Optimization and techn the SPPTS, MSPTS, and ETPTS we during this FYR period through the R 2012-02, 2014-01, 2014-04, 2014-08 2016-02). Optimization of the system nitrate and VOC concentrations in G the Walnut Creek drainage (see Sec GW treatment systems will continue 2015-09, and 2016-02 to ensure the
5. Prevent migration of contaminants that would result in exceedances of surface water RAOs.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR perio to prohibit soil disturbance without ap A reportable condition relating to the was detected in 2013, following a se RFLMA parties consulted on this rep plan to address the condition (CR 20 observations, additional evaluation w 09, 2015-03, 2015-06, 2016-03, and remains protective. Several repairs t system were completed during this F Reference source not found.) and Groundwater and surface water mon FYR period do not suggest the hillsid negatively affected groundwater or s
6. (Part 1) Prevent exposures that result in an unacceptable risk to the WRW. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at the site or multiple pathways of exposure (40 Code of Federal Regulations 300.430[e][2][i][A][2]).	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components ICs: • Perimeter signage • Activity restrictions • GW use restrictions • Digging restrictions • Construction restrictions	This RAO was met for this FYR perio assumptions for a wildlife refuge wor remain valid and human health risk r (Section 6.2.2). Institutional controls unacceptable exposures, including v place and effective, based on RFLM (Section Error! Reference source n A reportable condition relating to the was detected in 2013, following a se RFLMA parties consulted on this rep plan to address the condition (CR 20 observations, additional evaluation w 09, 2015-03, 2015-06, 2016-03, and remains protective. Several repairs t system were completed during this F Reference source not found.) and Groundwater and surface water mon FYR period do not suggest the repor negatively affected groundwater or s
(Part 2) Prevent significant risk of adverse ecological effects.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR perio conclusions remain valid and indicat adverse ecological effects at the Site conditions (e.g., unexpected mortalit during monitoring and maintenance a (2012 – 2016).

). The risks posed by the COCs left at the Rocky Flats Site following accelerated actions were evaluated in a comprehensive risk assessment (CRA) in 2006 (DOE, 2006a). The CRA evaluated the land area that encompasses the POU and the COU, divided into twelve exposure units (EUs) (Figure C-1). Because the CRA was completed by EU and not by OU (POU and COU), the

screening for this FYR review was conducted by EU and includes data from both the POU and COU. Under CERCLA, however, the FYR risk assessment review is strictly required for the COU as part of the protectiveness evaluation. A separate review of changes to risk assessment factors in relation to the UU/UE designations for the POU and OU3 is discussed in Appendix C.

Table 1 summarizes all COCs (chemical and radiological) for each EU for which risks were evaluated in the CRA. These are constituents for which residual soil concentrations exceeded site PRGs.

Table 1
Surface Soil COCs Identified for Each EU in the CRA

	Exposure Unit											
Constituent	**IAEU**	**UWOEU**	**WBEU**	**NNEU**	**UWNEU**	**LWOEU**	**RCEU**	**LWNEU**	**IDEU**	**WAEU**	**SWEU**	**SEEU**
Arsenic	X		X									
Vanadium				X								
2,3,7,8-TCDD		X										
Benzo[a]pyrene	X	X			X							
Plutonium 239/240		X										

"X" means constituent was designated as a COC in the 2006 CRA.

The PRGs represent concentrations for individual chemical constituents and radionuclides that would equate to a carcinogenic risk of 1×10^{-6} or a noncarcinogenic hazard quotient of 0.1 based on the exposure assumptions for the WRW. The PRGs were developed using toxicity data that were current at the time of the CRA and were developed for exposures to both surface and subsurface soils. Changes to the risk parameters (e.g., slope factors, toxicity data) used to calculate these PRGs may impact remedy protectiveness and must be evaluated in the FYR process. The methodology applied in evaluating the effects of changes in risk parameters adopted over this fourth FYR period is similar to the methodology used in the 2006 CRA and is summarized in Appendix C.

Figure 1 presents a summary of the screening process used in this FYR risk assessment review. As shown in the figure, the first step in this FYR risk assessment review was a comparison of the complete list of surface soil PRGs developed for the 2006 CRA to current EPA industrial soil regional screening levels (RSLs) (EPA, 2016). Of the more than 200 PRGs evaluated, slightly more than half were higher than the current RSL values (see Table C-5). Where PRGs were lower than current RSLs, it was assumed that results of the original CRA screening process are still valid and further evaluation of these constituents was not warranted. EPA RSLs that were lower than PRGs were compared to analytical data for each EU (i.e., maximum detected concentrations [MDCs] and 95 percent upper confidence level of the mean [95UCL]) used in the 2006 CRA. The MDC was the maximum concentration detected for a given constituent in each EU. The 95UCL is a conservative estimate of the average concentration for each EU. For

constituents passing these screens, additional evaluation was conducted using the same criteria used in the 2006 CRA (e.g., frequency of detection, professional judgment).

6.2.2.1 Chemical Constituents

Surface Soils. Table 2 shows the results of the rescreening process and highlights where FYR review results differed from the 2006 CRA. For the most part, the FYR screening confirmed the CRA results. However, there were a few inconsistencies, as discussed below.
The CRA used a more conservative toxicity value for vanadium and it was identified as a COC for the NNEU. Based on current EPA toxicity data, this constituent would be eliminated as a COC. Studies are ongoing with regard to vanadium, but risks may have been overestimated in the CRA. The FYR screening would include benzo(a)pyrene as a COC for the NNEU. The 95UCL was slightly higher than the RSL, indicating that residual risk would be slightly higher than 1 x 10^{-6} (about 1.1 x 10^{-6}). Neither of these changes affect the overall risk or protectiveness of the remedy.

Table 2
Surface Soil Chemical Constituents where 95UCL Exceeds Current Screening Level

	Exposure Unit											
Constituent	**IAEU**	**UWOEU**	**WBEU**	**NNEU**	**UWNEU**	**LWOEU**	**RCEU**	**LWNEU**	**IDEU**	**WAEU**	**SWEU**	**SEEU**
Arsenic	X		X									
Vanadium												
2,3,7,8-TCDD		X										
Benzo[a]pyrene	X	X		X	X							
Chromium (VI)	X	X	X	X	X	X	X	X	X	X	X	X
Dibenz[a,h]anthracene		X										

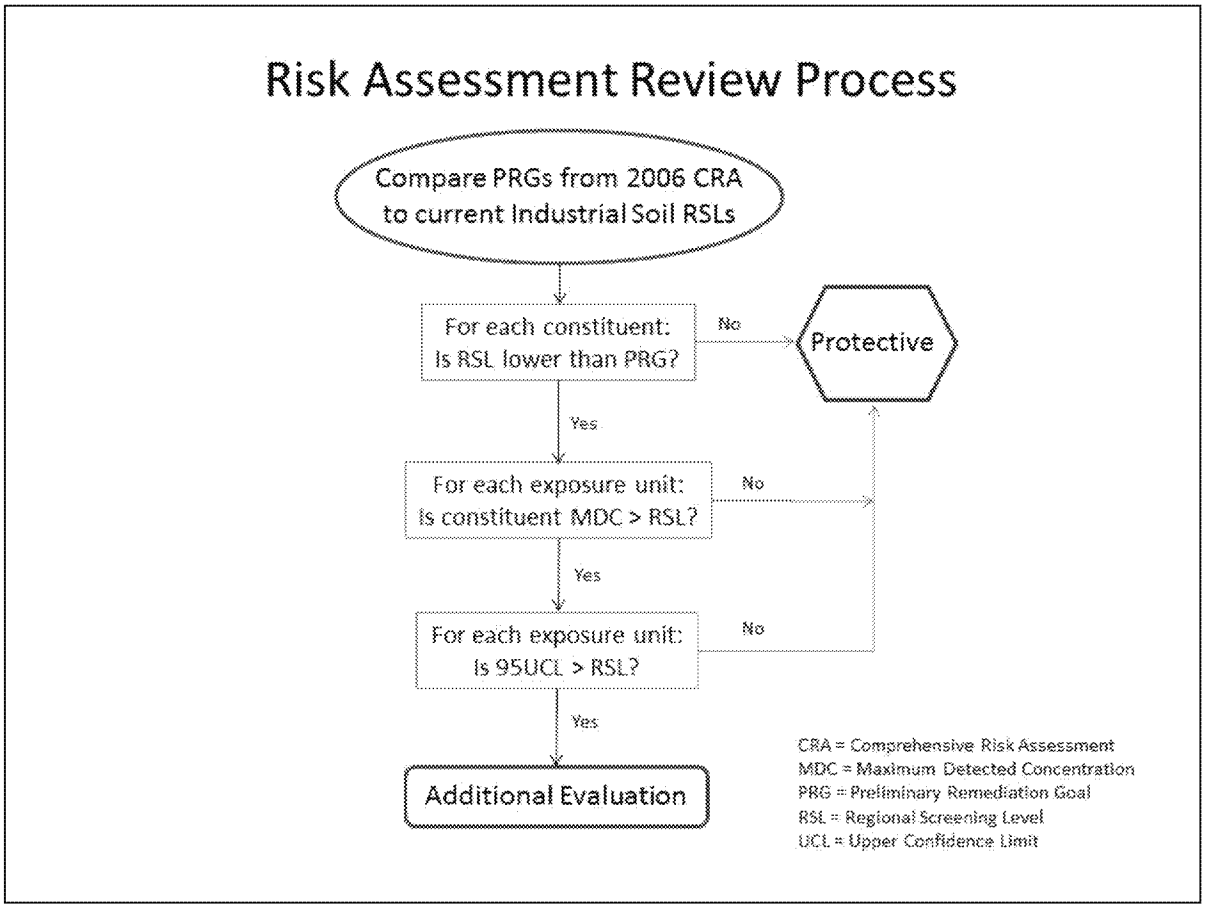
Shaded boxes differ with the CRA results.
"X" means constituent would be designated as a COC based on the CRA methodology

The most significant result of this FYR risk assessment review is that chromium passed the 95UCL screen for all EUs (i.e., chromium VI would be considered a COC using current EPA risk parameters). This is because of a new toxicity value for chromium VI that EPA has adopted in its RSL tables. Chromium occurs in two major forms—chromium III and chromium VI—of which chromium VI is more toxic. Though most analyses at the site were for total chromium (which does not distinguish valence states), in order to be conservative, these results were treated as chromium VI in the screening process and the WRW PRGs were developed using toxicity data for chromium VI.

The assumption that all chromium in site soils is chromium VI results in an overestimation of residual risks. The highest chromium VI concentration observed at the site was 0.85 mg/kg. Most chromium is likely in the chromium III form, which has a much higher screening level (EPA RSL of 125,000 mg/kg for unrestricted use). Chromium 95UCL concentrations for all but one EU are within the range of background. (LWOEU 95UCL is 26.7 mg/kg.) Furthermore, even if

all chromium at the site was chromium VI, risks associated with the residual concentrations would be between 10^{-5} and 10^{-6} for a WRW scenario—within the acceptable risk range. Therefore, even in the absence of additional chromium VI soil data, it can be concluded that residual soil concentrations are protective.

Figure 1
Fourth FYR Risk Assessment Review Process



Subsurface Soils. In the 2006 CRA, it was assumed that direct contact with contaminants in soils could occur at depths less than 8 ft. A screening process similar to that for surface soils was used, but with different PRGs. The PRGs for subsurface soils were developed based on less frequent exposures than for surface soils (e.g., a construction worker scenario). Subsurface PRGs in the CRA were approximately 11.5 times higher than surface soil PRGs. The CRA also evaluated the potential for VOCs in subsurface soils, including those greater than 8 ft in depth, to serve as a source of vapor intrusion.

Because no COCs were identified in the CRA for subsurface soils and because this FYR review of surface soil data indicated that the 2006 CRA process was sound, a less rigorous approach was taken in this FYR to answer Question B with regard to subsurface soils. An abbreviated PRG list was used for subsurface soil screening based on the results of the surface soil screening process. This included all constituents for which any surface soil MDC exceeded the surface soil PRG

(constituents listed in Table C-4 and last column in Table C-5); tetrachloroethene was also added to this list as it was identified as a subsurface AOI in the RI/FS (Table C-1). The current industrial soil RSLs were multiplied by 11.5 to obtain current estimates of subsurface PRGs. The screening with this smaller set of PRGs proceeded in the same manner as the surface soil FYR evaluation described above.

As with the subsurface soil screening done in the CRA a number of constituents passed the MDC screen, but were subsequently eliminated by the 95UCL screen. However, chromium passed the 95UCL screen for the UWOEU and WBEU based on the updated screening values and would be considered a potential COC. As discussed above, this is due to a new chromium VI slope factor that was adopted by EPA in its RSL tables. This is not expected to affect remedy protectiveness for the same reasons discussed above for surface soils (e.g., likelihood that most chromium is background and not chromium VI).

The vapor intrusion pathway is a potentially complete pathway for all subsurface soils. EPA has finalized guidance for evaluating the vapor intrusion pathway (EPA 2015) and has provided guidance for evaluating this pathway in during five-year reviews (EPA 2012c). Updated toxicity data is also available for some VOCs that are identified as AOIs in subsurface soils (e.g., tetrachloroethene, trichloroethene). Institutional controls are in place at the COU that eliminate the vapor intrusion pathway by prohibiting the construction of habitable structures. RAOs and cleanup goals remain valid and are not affected by updated guidance and toxicity data as long as institutional controls remain in place.

6.2.2.2 Radionuclides

[ADD section regarding radionuclide risk assessment.]

6.2.3 FYR Risk Evaluation Summary

- Exposure assumptions used are conservative and remain valid.
- The general Site Conceptual Model and assumption that the most likely exposure scenario for a human receptor is approximated by a WRW scenario is still valid for the COU.
- [Add statement about POU]
- The changes in some toxicity values should not affect the protectiveness of the remedy.
- Institutional controls are in place at the COU that eliminate the vapor intrusion pathway.
- RAOs and cleanup goals remain valid and are not affected by updated guidance and toxicity data as long as institutional controls remain in place.

[Add radionuclide summary bullets for COU, POU, and OU3]

6.2.4 RAO Status

The status of each RAO during this FYR period is presented in

Table *3. Fourth FYR RAO Status*

RAO	Remedy	FYR S
Groundwater		
7. Meet groundwater quality standards, which are the Colorado Water Quality Control Commission surface water standards, at groundwater AOC wells.	• GW monitoring at AOC wells	This RAO was met at all AOC wells c exception. A reportable condition for in 2015 (Section Error! Reference s with the RFLMA parties (CR 2015-10 condition to ensure the remedy rema FYR period, the most recent semiann concentration above the RFLMA star Analytical results from samples colle Woman Creek have not exceeded th during the evaluation period. The rer long-term because: (1) the 2016 data TCE concentration in this well, (2) TC water samples from Woman Creek c and (3) increased concentrations of T Woman Creek under conditions of hi were predicted at Site closure (Kaise
8. Restore contaminated groundwater that discharges directly to surface water as base flow, and that is a significant source of surface water, to its beneficial use of surface water protection wherever practicable in a reasonable timeframe. This is measured at groundwater Sentinel wells. Prevent significant risk of adverse ecological effects.	• GW monitoring at Sentinel wells • Monitoring & maintenance of GW treatment systems • GW treatment prior to reaching SW	This RAO was not met at all Sentinel Sentinel well data exceeded RFLMA and uranium. Optimization and techn the SPPTS, MSPTS, and ETPTS we during this FYR period through the R 2012-02, 2014-01, 2014-04, 2014-08 2016-02). Optimization of the system nitrate and VOC concentrations in GW the Walnut Creek drainage (see Sec found.). Optimization of the GW trea accordance with CRs 2015-08, 2015 remedy remains protective. The ecological risk assessment conc there is no significant risk of adverse evidence of adverse biological condit morbidity) was observed during mon during this FYR period (2012 – 2016
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Surface Water		

RAO	Remedy	FYR S
3. Meet surface water quality standards, which are the Colorado Water Quality Control Commission surface water standards.	• SW monitoring at POCs	This RAO was not met at WALPOC f 12-month rolling average for U excee quality standard for a 4-month period Reference source not found.). Con (CR 2015-01) resulted in a plan to ev remedy remains protective. Evaluatio system suggests that the increase in attributable to heavy precipitation eve U and increase the volume of ground (Wright Water Engineers, 2015). The because (1) no new anthropogenic s varying levels of U may be explained concentrations exiting the COU have drinking water standards. Although th directly applicable to the Site, compa standard offers perspective on the qu site.

RAO	Remedy	FYR S
Soil		
7. Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.	• GW monitoring at Sentinel wells • GW treatment prior to reaching SW	This RAO was not met at all Sentinel Sentinel well data exceeded RFLMA and uranium. Optimization and techn the SPPTS, MSPTS, and ETPTS we during this FYR period through the R 2012-02, 2014-01, 2014-04, 2014-08 2016-02). Optimization of the system nitrate and VOC concentrations in G the Walnut Creek drainage (see Sec GW treatment systems will continue 2015-09, and 2016-02 to ensure the
8. Prevent migration of contaminants that would result in exceedances of surface water RAOs.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR perio to prohibit soil disturbance without ap A reportable condition relating to the was detected in 2013, following a se RFLMA parties consulted on this rep plan to address the condition (CR 20 observations, additional evaluation w 09, 2015-03, 2015-06, 2016-03, and remains protective. Several repairs t system were completed during this F Reference source not found.) and Groundwater and surface water mon FYR period do not suggest the hillsid negatively affected groundwater or s
9. (Part 1) Prevent exposures that result in an unacceptable risk to the WRW. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at the site or multiple pathways of exposure (40 Code of Federal Regulations 300.430[e][2][i][A][2]).	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components ICs: • Perimeter signage • Activity restrictions • GW use restrictions • Digging restrictions • Construction restrictions	This RAO was met for this FYR perio assumptions for a wildlife refuge wor remain valid and human health risk r (Section 6.2.2). Institutional controls unacceptable exposures, including v place and effective, based on RFLM (Section Error! Reference source n A reportable condition relating to the was detected in 2013, following a se RFLMA parties consulted on this rep plan to address the condition (CR 20 observations, additional evaluation w 09, 2015-03, 2015-06, 2016-03, and remains protective. Several repairs t system were completed during this F Reference source not found.) and Groundwater and surface water mon FYR period do not suggest the repor negatively affected groundwater or s
(Part 2) Prevent significant risk of adverse ecological effects.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR perio conclusions remain valid and indicat adverse ecological effects at the Site conditions (e.g., unexpected mortalit during monitoring and maintenance a (2012 – 2016).

. The RAOs and ARARs in the CAD/ROD remain relevant in addressing residual contamination and potential exposure pathways at the Site and assessing remedy protectiveness. Not all RAOs were met during this FYR period, however, the remedy is designed to achieve all RAOs in the long-term. No revisions to the RAOs established in the CAD/ROD are recommended.

Table 3. Fourth FYR RAO Status

RAO	Remedy	FYR Status
Groundwater		
10. Meet groundwater quality standards, which are the Colorado Water Quality Control Commission surface water standards, at groundwater AOC wells.	• GW monitoring at AOC wells	This RAO was met at all AOC wells during this FYR period, with one exception. A reportable condition for TCE in AOC well 10304 occurred in 2015 (Section Error! Reference source not found.). Consultation with the RFLMA parties (CR 2015-10) resulted in a plan to evaluate the condition to ensure the remedy remains protective. At the end of this FYR period, the most recent semiannual data show a TCE concentration above the RFLMA standard at AOC well 10304. Analytical results from samples collected downstream of well 10304 in Woman Creek have not exceeded the surface water standard for TCE during the evaluation period. The remedy remains protective in the long-term because: (1) the 2016 data suggest a decreasing trend in TCE concentration in this well, (2) TCE was not detected in surface water samples from Woman Creek collected downgradient of the well, and (3) increased concentrations of TCE in groundwater discharging to Woman Creek under conditions of higher-than-normal precipitation were predicted at Site closure (Kaiser-Hill 2004).
11. Restore contaminated groundwater that discharges directly to surface water as base flow, and that is a significant source of surface water, to its beneficial use of surface water protection wherever practicable in a reasonable timeframe. This is measured at groundwater Sentinel wells. Prevent significant risk of adverse ecological effects.	• GW monitoring at Sentinel wells • Monitoring & maintenance of GW treatment systems • GW treatment prior to reaching SW	This RAO was not met at all Sentinel wells during this FYR period. Sentinel well data exceeded RFLMA standards for some VOCs, nitrate, and uranium. Optimization and technical improvement opportunities at the SPPTS, MSPTS, and ETPTS were identified and implemented during this FYR period through the RFLMA consultative process (CRs 2012-02, 2014-01, 2014-04, 2014-08, 2015-04, 2015-08, 2015-09, and 2016-02). Optimization of the systems has resulted in reductions of nitrate and VOC concentrations in GW prior to reaching surface water in the Walnut Creek drainage (see Section Error! Reference source not found.). Optimization of the GW treatment systems will continue in accordance with CRs 2015-08, 2015-09, and 2016-02 to ensure the remedy remains protective. The ecological risk assessment conclusions remain valid and indicate there is no significant risk of adverse ecological effects at the Site. No evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) was observed during monitoring and maintenance activities during this FYR period (2012 – 2016).
12. Prevent domestic and irrigation use of groundwater contaminated at levels above MCLs.	ICs • Drinking/agricultural SW use prohibited. • GW well drilling prohibited. • Any activities that interfere with remedy actions	This RAO was met for this FYR period. Institutional controls recorded in the environmental covenant have been effective in preventing domestic and irrigation use of groundwater from the Site. The results of RFLMA routine inspections confirm that no unauthorized intrusive activities have

RAO	Remedy	FYR Status
	prohibited except when in accordance w/ RFLMA.	occurred at the Site during this FYR period (Section Error! Reference source not found.).
Surface Water		
4. Meet surface water quality standards, which are the Colorado Water Quality Control Commission surface water standards.	• SW monitoring at POCs	This RAO was not met at WALPOC for this FYR period. The WALPOC 12-month rolling average for U exceeded the site-specific surface water quality standard for a 4-month period in 2014/2015 (Section Error! Reference source not found.). Consultation with the RFLMA parties (CR 2015-01) resulted in a plan to evaluate the condition to ensure the remedy remains protective. Evaluation of the Walnut Creek drainage system suggests that the increase in U concentrations may be attributable to heavy precipitation events which increase the mobility of U and increase the volume of groundwater discharged to surface water (Wright Water Engineers, 2015). The remedy remains protective because (1) no new anthropogenic source of U has been identified; (2) varying levels of U may be explained by natural processes, and (3) U concentrations exiting the COU have always been well below national drinking water standards. Although the drinking water standards are not directly applicable to the Site, comparison with the drinking water standard offers perspective on the quality of surface water exiting the site.

RAO	Remedy	FYR Status
Soil		
10. Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.	• GW monitoring at Sentinel wells • GW treatment prior to reaching SW	This RAO was not met at all Sentinel wells during this FYR period. Sentinel well data exceeded RFLMA standards for some VOCs, nitrate, and uranium. Optimization and technical improvement opportunities at the SPPTS, MSPTS, and ETPTS were identified and implemented during this FYR period through the RFLMA consultative process (CRs 2012-02, 2014-01, 2014-04, 2014-08, 2015-04, 2015-08, 2015-09, and 2016-02). Optimization of the systems has resulted in reductions of nitrate and VOC concentrations in GW prior to reaching surface water in the Walnut Creek drainage (see Section 6.1.4.3). Optimization of the GW treatment systems will continue in accordance with CRs 2015-08, 2015-09, and 2016-02 to ensure the remedy remains protective.
11. Prevent migration of contaminants that would result in exceedances of surface water RAOs.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR period. Institutional controls are in place to prohibit soil disturbance without appropriate controls. A reportable condition relating to the effectiveness of the OLF cover was detected in 2013, following a severe storm and flooding event. The RFLMA parties consulted on this reportable condition and developed a plan to address the condition (CR 2013-02). In response to subsequent observations, additional evaluation was warranted (CRs 2013-03, 2014-09, 2015-03, 2015-06, 2016-03, and 2016-04) to ensure the remedy remains protective. Several repairs to the OLF stormwater management system were completed during this FYR period (Section Error! Reference source not found.) and additional actions are planned. Groundwater and surface water monitoring data collected during this FYR period do not suggest the hillside instability at the OLF has negatively affected groundwater or surface water quality.
12. (Part 1) Prevent exposures that result in an unacceptable risk to the WRW. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at the site or multiple pathways of exposure (40 Code of Federal Regulations 300.430[e][2][i][A][2]).	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components ICs: • Perimeter signage • Activity restrictions • GW use restrictions	This RAO was met for this FYR period. The land use and exposure assumptions for a wildlife refuge worker (WRW) used in the CRA remain valid and human health risk remains below the 10^{-6} risk level (Section 6.2.2). Institutional controls and physical controls to prevent unacceptable exposures, including via the indoor air pathway, are in place and effective, based on RFLMA inspection and monitoring results (Section Error! Reference source not found.). A reportable condition relating to the effectiveness of the OLF cover was detected in 2013, following a severe storm and flooding event. The RFLMA parties consulted on this reportable condition and developed a plan to address the condition (CR 2013-02). In response to subsequent observations, additional evaluation was warranted (CRs 2013-03, 2014-09, 2015-03, 2015-06, 2016-03, and 2016-04) to ensure the remedy

RAO	Remedy	FYR Status
	• Digging restrictions • Construction restrictions	remains protective. Several repairs to the OLF stormwater management system were completed during this FYR period (Section Error! Reference source not found.) and additional actions are planned. Groundwater and surface water monitoring data collected during this FYR period do not suggest the reportable condition at the OLF has negatively affected groundwater or surface water quality.
(Part 2) Prevent significant risk of adverse ecological effects.	• Repair and maintenance of landfill covers, vegetation • Ongoing protection of remedy components	This RAO was met for this FYR period. The ecological risk assessment conclusions remain valid and indicate there is no significant risk of adverse ecological effects at the Site. No evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) was observed during monitoring and maintenance activities during this FYR period (2012 – 2016).